Journal of Surgical Oncology 2000;73:117–124

REVIEW ARTICLE

Hemicorporectomy

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In hemicorporectomy, or translumbar amputation, the bony pelvis, pelvic contents, lower extremities, and external genitalia are removed following disarticulation of the lumbar spine and transection of the spinal cord. Malignancies of the pelvic organs, skin, or musculoskeletal structures, usually locally advanced, may be indications for hemicorporectomy. The absence of systemic metastasis must be demonstrated before considering hemicorporectomy. Sacral decubitus ulcers and other complications of paraplegia represent the most frequent benign indications.

Hemicorporectomy is a complex, multistep procedure with significant physiologic and psychologic implications. Postoperative morbidity and mortality rates are high, partly because of the complexity of the procedure itself and partly due to the underlying disease. Detailed planning, from preoperative evaluation to rehabilitation, is the key to a successful outcome. The procedure may be carried out in one stage or in multiple stages, depending on the clinical circumstances. Multidisciplinary collaboration of many health care professionals should be part of the planning process and must be carefully coordinated.

Postoperative management requires particular attention to fluid replacement, temperature control, and pulmonary care. Posthospitalization rehabilitation includes the design and construction of a bucket prosthesis. Long-term management issues involve hypertension, weight gain, temperature control, stoma management, and skin care.
J. Surg. Oncol. 2000;73:117–124.

KEY WORDS: hemicorporectomy; translumbar amputation

HISTORICAL BACKGROUND

Hemicorporectomy entails disarticulation of the lumbar spine and transection of the spinal cord with resection of the bony pelvis, rectum, bladder, genitalia, and both lower extremities. Historically, the concept of hemicorporectomy, or translumbar amputation, was first described by Frederick E. Kredel, professor of surgery at the Medical College of South Carolina. During a discussion on pelvic exenteration at the Society of University Surgeons meeting in Durham, North Carolina in 1950, Dr. Kredel proposed what he then called a “halfectomy” for oncologic cases too far advanced for exenteration. He had previously performed the procedure on a cadaver and showed a slide of the finished product to his colleagues [1,2]. Although not taken seriously by many at the time, this was the first mention of such an ultraradical proce-

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Accepted 22 October 1999

dure in professional circles. Kredel envisioned the procedure as a curative operation for locally invasive cancers confined to the pelvis and lower body that had been unresponsive to other more traditional treatments [1,2]. His demonstration of cadaver studies preceded the successful performance of the operation by 10 years. Kredel died in 1961 never having performed the procedure on a living subject. He did, however, complete the first stage of a planned two-stage hemicorporectomy in 1951. The patient had a locally invasive pelvic cancer but, after completion of urinary and fecal diversions, refused further surgery [2].

The first clinical attempt at translumbar amputation was performed by Kennedy et al. [3] at Grace Hospital in Detroit on February 13, 1960. The patient was a 74-year-old male with rectal cancer who had previously undergone abdominoperineal resection. The procedure was performed in one stage and lasted 13 hr. Death on postoperative day 11 was due to pulmonary edema incurred after blood transfusion. Although long-term survival was not accomplished, Kennedy et al. [3] proved that the operation was technically feasible.

The first successful hemicorporectomy was performed in October of 1961 by Aust and Absolon [4] at the University of Minnesota. The patient was 29 years old and had been paraplegic since repair of a meningomyelocele at birth. He developed squamous cell carcinoma in a longstanding sacral decubitus ulcer. The operation was performed in 2 stages, and the final procedure required 6.5 hr. Nineteen years later, while being treated for heatstroke with crystalloid resuscitation, the patient developed acute respiratory failure and hypotension and died [5].

In July of 1963, Yancey et al. [6] performed the third translumbar amputation on a 58-year-old woman with multiple complications from a locally advanced cervical cancer. The operation lasted 7 hr, and she died on the fourth postoperative day from pulmonary edema.

All of the first 3 reported cases died of pulmonary edema, although one survived 19 years postoperatively. Learning from others' mistakes, in 1966 Miller et al. [7] reported a series of 4 cases at Memorial Hospital in New York with no operative mortality. Since the procedure was first described, only 44 cases have been reported in the world literature, although numerous others remain unpublished [8].

INDICATIONS FOR SURGERY

When hemicorporectomy was first proposed, the indications were few, e.g., locally advanced cancer confined to the pelvis and lower body that had failed more traditional therapies. While the indications have increased, it will never be a commonly performed procedure. Hemicorporectomy is a radical surgical procedure recommended as a measure of last resort for patients with a life-threatening diagnosis [9]. Due to the magnitude of the operation, use as a palliative procedure is precluded [7]. Prior to considering translumbar amputation, all other measures, including conventional surgery, radiation therapy, and chemotherapy, should be exhausted [2]. This devastating operation should not be advocated without careful consideration of the likelihood of rehabilitation [2]. The process of rehabilitation is costly and lengthy, and only patients with fierce determination to survive should be considered.

The indications can be divided into two broad categories: slow-growing malignancies confined to the lower body and certain benign conditions, most of which are complications of paraplegia [5,10]. Pelvic tumors should be inoperable by abdominoperineal resection, pelvic exenteration, or hemipelvectomy with absolute absence of evidence of tumor metastasis outside the pelvis [11]. The biologic nature of the tumor should be compatible with prolonged survival [7,11]. This procedure has been performed for carcinomas of the bladder, cervix, and vagina; sarcoma of the prostate; as well tumors involving the pelvic bone, including giant cell tumors of the sacrum, chondrosarcomas, and sacral chordomas [7].

Patients with chordomas who have failed local resection or irradiation prove to be excellent candidates for hemicorporectomy because these tumors grow slowly and rarely spread to distant sites. Most of these patients eventually die from complications associated with local invasion, such as intestinal or urinary obstruction, bleeding, or sepsis [9]. Paraplegics represent the majority of translumbar amputations for benign processes. Complications that may lead to hemicorporectomy include benign intractable decubitus ulcers, chronic ulcers in which squamous cell carcinoma has developed, and osteomyelitis involving the pelvic bones [9]. After suffering extended periods of time with pain, infection, malodorous discharge, and repeated hospitalizations, acceptance of this drastic procedure is often not difficult [2]. Additionally, removal of the lower extremities may not be perceived as such a devastating loss to many paraplegics. Removal of nonfunctioning dead body weight may actually facilitate mobility.

Other indications reported in the literature include severe crushing trauma to the pelvis and lower extremities [1,12], as well as acute aortic occlusion [13]. It has also been used as a last resort in the treatment of a pelvic arteriovenous malformation that resulted in complications of massive bleeding, soft tissue necrosis, sepsis, congestive heart failure, and bowel and bladder incontinence [9].

PREOPERATIVE EVALUATION

With malignant disease, it is of utmost importance to evaluate the patient for the presence of metastasis. Evidence to determine whether the tumor is confined to the

pelvis may be obtained from chest radiographs, computed axial tomography, or exploratory laparotomy. Because hemicorporectomy is often completed in 2 stages, the first stage (when the colostomy and ileal conduit are fashioned) can also be used as a formal exploration to search for abdominal metastases. Evaluation of the patient's nutritional status is recommended. Enteral or parenteral supplementation may be warranted to restore positive nitrogen balance. Aust and Absolon [4], who performed the first successful translumbar amputation, gave their patient high-protein supplements and improved the serum albumin level from 2.1 to 3.2 g/dl prior to operation.

An important component in the preoperative workup is psychologic evaluation. To cope with the extensive physical and emotional consequences of this procedure, the patient must demonstrate both emotional and psychologic maturity. The patient must have a strong desire to live and the mental fortitude to endure the intense rehabilitation process that is necessary after removal of the lower half of the body [9]. Physical therapy for strengthening the upper body may begin preoperatively [2]. Counseling may be desirable to moderate depression and anxiety and to help patients cope with changes in body image and sexual identity. Discussion should also begin about job training and vocational opportunities [2].

A multidisciplinary team headed by a surgical oncologist or general surgeon is recommended. It is helpful for all health care providers to be available to the patient preoperatively. Detailed discussions should be held with the patient and the family about the surgical procedure, the possible morbidity, and the physical rehabilitation [9]. It should also be made clear exactly what parts of the anatomy are to be removed and the resultant functional limitations [9]. All questions should be answered and misconceptions addressed. It is extremely difficult for patients and their families to envision the end result. It is helpful for the patient and family members, as well as the operating room, recovery room, and floor personnel, to be shown pictures of the final physical state prior to surgery [6]. This helps to alleviate the shock of the first postoperative encounter. The opportunity to meet and talk with an individual who has also undergone translumbar amputation can be very beneficial to both patient and family.

PLANNING AND STAGING OF PROCEDURE

Once the decision has been made to proceed with hemicorporectomy, detailed planning of the procedure is critical. The multidisciplinary team should include a surgical oncologist/general surgeon, urologist, anesthesiologist, possibly a plastic surgeon, neurosurgeon, orthopedist, and psychologist, as well as nurses, social workers, and physical, occupational, and enterostomal therapists. A formal planning session with all members of the team present is a useful educational and implementation process. The medical history is presented, and the intraoperative procedure as well as the details of postoperative care are reviewed. All nursing concerns can be addressed at this time. If more than one surgeon is to participate in the case, the order of events and responsibilities of each should be delineated. The anesthesiologist must recognize the issues unique to translumbar amputation, including the abrupt loss of 40%–55% of body weight that will occur during the operation. The possibility of longstanding narcotic addiction must be considered, and a thorough preoperative evaluation by the anesthesia service is mandatory [14].

The next important decision is whether the procedure will be performed in 1 stage or 2. The 1-stage operation is unnecessarily long and involves greater blood loss and increased potential for serious complications. In a report of 6 consecutive hemicorporectomies, Terz et al. [9] documented major complications in 5, including urinary fistulae, small bowel obstruction, intraabdominal bleeding requiring reoperation, and small bowel fistula. To reduce the physiologic and hemodynamic stress and obviate potential complications, we believe the procedure should be done in 2 stages. During the first stage, abdominal exploration is carried out to confirm that the tumor is confined to the pelvis and lower body if the underlying disease process is malignancy [7]. If it is determined that a lesser operation would not provide complete removal of the tumor, a colostomy and ileal conduit are fashioned. Stomas must be placed above the level of the umbilicus because the lower abdominal wall will make up a portion of the "stump." If located too far caudad, the stomas will interfere with closure of the second stage and hinder appropriate fitting of the bucket prosthesis. Preliminary urinary and bowel diversion shortens the time required for translumbar amputation and allows the second stage to be carried out entirely in an extraperitoneal plane [11]. This minimizes manipulation of the intestine and promotes more rapid return of bowel function. A 2-stage procedure also avoids opening the intestine while the spinal cord is being transected. This decreases the risk of contamination of the dural space and postoperative meningitis. Control of infection is essential. When hemicorporectomy is carried out for intractable pelvic sepsis, aggressive preoperative antibiotics will decrease the risk of infectious complications. All patients should be given perioperative antibiotics. Formal bowel preparation should be performed.

INTRAOPERATIVE PLANNING

Certain aspects of hemicorporectomy deserve special attention in the operating room. The anesthesiologist must be aware of the circumstances that make this operation unique from all others. As with any major procedure where hemodynamic fluctuations are expected, an

arterial line and pulmonary artery catheter should be placed. Overtransfusion and overly aggressive resuscitation must be avoided. Blood loss must be carefully monitored and fluid replacement accurate. If unsure about appropriate fluid management, the anesthesiologist must err on the side of underresuscitation. The blood volume is approximately halved at the time the great vessels are ligated, and thereafter pulmonary edema may occur rapidly [7]. The loss of the lower half of the body as a reservoir for third-space fluids must be appreciated. Perioperative mortality is extremely high with the onset of pulmonary edema. Autotransfusion is utilized to reduce the amount of banked blood required during the procedure. After ligation of the common iliac arteries or the distal aorta, the patient either is placed in Trendelenburg's position or the lower extremities are elevated to allow blood return to the central vasculature. Once the central venous pressure (CVP) begins to rise or remains stable for several minutes, the inferior vena cava is ligated [2,15]. Overtransfusion can be avoided by constant careful monitoring of CVP and pulmonary capillary wedge pressure. The replacement rate must be reduced when filling pressures rise. Ligation of the aorta also marks the moment when the body weight is effectively reduced by half. From this point on, appropriate compensation must be made when calculating drug dosage and fluid requirements [15].

Another critical point in the operation occurs with transection of the spinal cord. Division of the cauda equina has been followed by a dramatic drop in arterial pressure, usually treated with volume loading to restore normotension [14]. Once again, this rapid bolus therapy must be done judiciously after ligation of the great vessels. Sudden, profound hypotension can occur even when the patient is hemodynamically stable and filling pressures are adequate [14]. Tachyarrhythmias have also been reported to accompany these bouts of hypotension. The mechanism of action is similar to neurogenic shock, in which reflex activity below the level of injury is lost [14]. Hypotension has also been described during division of the lumbar musculature [2]. Many authors have advocated the use of epidural morphine or the infiltration of local anesthetic into the cauda equina prior to transection, to prevent this hemodynamic instability [2,14,15].

Of special concern to the nursing staff is the issue of patient preparation. In a suggested approach, the patient is intubated while still on the stretcher, the operating room table is lined with sterile drapes, and the side of the patient to be down on the operating table is prepped. The prep extends cephalad to the nipple line and includes both legs circumferentially. A sterile drape is placed under the legs after this portion of the prep is finished. The patient is then logrolled onto the operating table, and the remainder of the prep is completed. A novel approach to facilitate containment of the specimen when the amputation is complete involves placing a sterile plastic bag, such as a C-arm drape, around the lower extremities before the case is begun [16]. Warming blankets are placed on the bed and the patient's upper torso to help maintain normothermia.

Antibiotics should be administered at regular intervals throughout the procedure, especially if chronic infection such as osteomyelitis is present. With disruption of the dura in a contaminated field, therapeutic blood levels must be maintained. It is beneficial to weigh the specimen prior to disposal, to obtain an accurate dry weight for the patient postoperatively.

Consideration should be given to the procurement of split-thickness skin grafts or skin or myocutaneous flaps from the amputated lower extremities [15]. Wound problems are not uncommon, and split skin grafts can be stored for use at a later time. Free skin or myocutaneous flaps can be used for wound closure if needed. The prospect of plastic surgical assistance in closure should be determined preoperatively.

POSTOPERATIVE CARE

The dramatic anatomic and physiologic changes that are produced following hemicorporectomy make postoperative care of these patients unique. Removal of a large proportion of the body mass produces a situation in which the usual guides to postoperative care are absent [17]. Baselines traditionally used to assess fluid replacement are so substantially altered that they are no longer applicable [17]. It is essential to realize that amputation of the lower extremities removes a large reservoir that in other patients can compensate for errors in overresuscitation. Reduction in the volume of the peritoneal cavity may also be a contributing factor [15]. For this reason, overhydration is not tolerated, leading quickly to pulmonary edema or congestive heart failure that may be fatal. Mild underhydration is therefore recommended in the early postoperative period to avoid such serious complications [15]. Fluid and electrolyte requirements should be calculated on the remaining body weight, much in the same manner as with pediatric patients. Inputs and outputs should be monitored precisely. Determination of accurate weights twice daily is also essential in fluid management [7]. A fairly accurate dry weight can be obtained by weighing the surgical specimen in the operating room and subtracting this value from the preoperative weight. After hemicorporectomy, the body weight is reduced 40%–55%. Blood volume is not reduced in proportion to body weight. Total blood volume is sharply decreased, but postoperative volumes constitute a higher percentage of the remaining body weight [2]. While preoperative measurements in milliliters per kilogram body weight are approximately 7.5%, postoperative volumes rise to 10% [2,7]. This can be explained through the retention of anatomic areas that contain proportionally large volumes

of blood. The splanchnic bed, pulmonary circulation, and heart chambers remain intact [2,7]. The surgeon must remember that the reduction in total blood volume begins the instant the arterial supply to the lower body is severed. The time to reduce infusion rate of fluids and medications is immediately upon ligation of the distal aorta or iliac arteries [11]. Even the most accurate blood volume determinations cannot guide volume replacement [17]. Postoperatively, one relies on blood pressure, pulse, urinary output, and parameters obtained from pulmonary artery catheters to judge the adequacy of circulating blood volume.

Cardiac output remains unchanged in both the immediate and the late postoperative periods. When the reduction in body surface area is taken into account and outputs are evaluated in liters per minute per square meter of body surface area (cardiac index), values are markedly increased postoperatively [2,7,18].

Total oxygen consumption falls only 11%–12% by the third postoperative week, and late in convalescence it falls to 17.5%–32% below preoperative levels. Although total oxygen consumption is reduced with the near 50% reduction in body weight, consumption in milliliters per square meter per minute remains markedly elevated throughout the postoperative period [7].

Under normal circumstances, the main mechanisms for dissipation of heat both at rest and during mild exercise are convection and conduction. As the work load progressively increases and the need for greater heat loss grows, evaporative losses through sweating gradually become more important [19]. During exercise with increased heat production, the muscles and skin are used to store heat to prevent overheating the body's core and the temperature of these areas rises. After hemicorporectomy, extensive sweating occurs from light and moderate work loads [19]. Although the ability to produce heat is reduced, the capacity to store excess heat is more markedly reduced. Factors which impair heat loss in these patients are the 40% loss of skin surface area, loss of a huge reservoir of muscle mass that can no longer be used as a heat-storage area, and to a lesser degree the prosthesis [19]. While body temperature is adequately regulated during mild exercise for prolonged periods, these patients must resort to sweating to maintain this thermoregulation [19]. Monitoring temperature postoperatively is essential to avoid the predisposition to hyperthermia [20]. Patients should also be cautioned about the potential dangers of prolonged physical activity, especially in warm environments [19].

Many aspects of respiratory function and physiology are altered after translumbar amputation. Since the lungs and the diaphragm are not directly violated during surgery, most patients should be able to resume spontaneous ventilation in the immediate postoperative period [15]. Occasionally, untoward perioperative events may require prolonged mechanical ventilation. Postoperatively, these patients have a substantial reduction in functional residual capacity, which is further decreased when the patient lies down [2]. This is most likely due to decreased abdominal compliance. Total lung capacity and residual volume are also reduced; only inspiratory capacity is near normal [21]. In similar fashion, these changes are accounted for by the reduced abdominal volume and altered mechanical properties of the abdominal wall [2]. In a normal individual at rest, tidal volume is distributed preferentially to the basal regions of the lung [21]. After hemicorporectomy, the reverse is true: the middle and apical regions of the lung are better aerated than the bases. The relevance of these findings is that, when possible, patients should avoid situations that lead to uneven distribution of ventilation, such as smoking and airway infection. Next, one can look at regional expansion for different lung volumes. In the normal individual, alveoli are progressively more expanded as one moves apically in the lung. After translumbar amputation, basal regions are more expanded, both at residual volume and at functional residual capacity [21]. The end result postoperatively is that the basal regions of these patients' lungs are comparatively underventilated and overexpanded [21]. Airway closure occurs in the normal individual at low volumes in the basal regions of the lung. After hemicorporectomy, these airways begin to close at volumes of 14% of vital capacity, which exceed functional residual capacity [21]. Therefore, airway closure may occur during normal tidal respiration, which may help to explain the reduced ventilation of the basal portions of the lung [21]. This reduction in basal ventilation leads to ventilation-perfusion abnormalities. Gas-exchange studies show a normal physiologic dead space but increased alveolo-arterial oxygen differences both at rest and during exercise [21].

The huge reduction in body weight removes not only the greater portion of the muscle mass but, along with it, a tremendous volume of intracellular buffers [7]. This can lead to rapid fluctuations in acid-base balance, which can become difficult to control if not monitored carefully [2,7].

Phantom pain has never been reported to be a serious problem and has been controlled with the usual doses of common analgesics [7]. These pains usually disappear after patients become more active and advance in their rehabilitation [2]. Hormone replacement is also necessary and usually begins at physiologic levels approximately 1 to 2 weeks after surgery [7].

NURSING MANAGEMENT

Often, the first reaction of the nursing staff is negative when they learn that a hemicorporectomy is to be performed. They may be reticent to participate in a procedure that is so permanently disfiguring, especially if the

operation has never been performed in that facility [16]. Any new procedure may be approached with hesitance due strictly to unfamiliarity, but a procedure of this magnitude evokes emotional and ethical concerns as well. Although the nursing staff may have participated in numerous radical and disfiguring surgeries, they may have difficulty accepting the magnitude of the alteration in body image and the resultant implications for this type of patient [16]. Some institutions have enlisted the services of their psychology departments to provide the nursing staff with support and guidance to help resolve these feelings. Nursing personnel may wonder how anyone who is well informed would accept such a procedure; but given time and allowed to discuss things rationally, negative feelings usually begin to wane [16]. They often develop a close bond with the patient and respect his or her courage and desire to live. It is beneficial to provide the nursing staff with literature that describes the surgery. They will also be more comfortable if given enough notice preoperatively to formulate their own nursing care plan.

Areas which must be attended to with vigilance by the nursing staff include pulmonary function, wound care, and ostomy function. Because of the altered respiratory dynamics outlined earlier, pulmonary demise may be sudden and irreparable. Any change in respiratory status must be taken seriously and the physician notified immediately. Nurses must take an active role in pulmonary physiotherapy, including turning, coughing, deep breathing, adequate administration of pain medication, and patient mobilization.

Wound care must be meticulous. Problems with wound breakdown or infection are not uncommon, especially in those undergoing hemicorporectomy for recalcitrant pelvic sepsis. Wounds must be scrupulously attended for any alteration in skin integrity or signs of infection. Ostomies must be carefully isolated from the wound at all times. Increased mobility is important to help maintain flap viability and prevent pressure ulcerations.

Ostomy output must be carefully recorded from both urinary and fecal conduits. This is a measure of fluid and acid-base balance. With the loss of major portions of the buffering systems, abnormally high outputs are not well tolerated and can lead to dangerous metabolic disturbances.

COMPLICATIONS

The complications that follow hemicorporectomy include those encountered after any major abdominal surgery coupled with a few that are unique to the procedure. Wound problems predominate and range from minor wound breakdown requiring simple wound care to wound dehiscence. Because the procedure requires interruption of the aorta at its bifurcation, the skin flaps are deprived of all arterial contributions that originate from the iliac system. The arteriovenous supply to the abdominal wall is abundant, and viability is maintained through collateralization from the cephalad circulation [20]. The arterial supply includes the superior epigastric, posterior intercostal, subcostal, lateral thoracic, lumbar, and inferior phrenic arteries. Cadaver studies using intravascular injections have demonstrated extensive arborization through perforating vessels; thus, the potential for development of collaterals and redirection of flow is substantial [20]. Wound infections and systemic sepsis are common when translumbar amputation is performed on patients with osteomyelitis or visceral sinuses and fistulae [2]. Skin and soft tissue necroses have been severe enough to require rotation of bilateral, full-thickness fasciocutaneous flaps into the wound [20]. Hemicorporectomy has occasionally been performed as a salvage procedure after severe trauma [12]. In cases with associated soft tissue destruction, it may be difficult to obtain adequately sized, viable flaps. In one such case, after debridement of a nonviable skin flap, the wound was initially covered with a homograft from the patient's father and ultimately grafted with split-thickness skin from the patient's chest and arms [12]. Similarly a patient who underwent hemicorporectomy for a paraplegic buttock decubitus culminating in osteomyelitis and advanced pelvic sepsis developed postoperative wound sepsis. Wound breakdown left the most distal vertebral body and the ligated meninges exposed, which required multiple operative wound debridements. Aggressive wound care was provided until a healthy granulated surface was obtained, at which time a split-thickness skin graft was taken from the chest [5].

When the vertebral body or disk is exposed, a split-thickness graft may not be adequate. Delayed full-thickness flaps have been used to cover this area and provide a more durable surface for future weight bearing [12]. Because complicated wound problems are so common and donor areas are limited postoperatively, it is wise to harvest skin grafts from the lower extremities at the time of amputation and to store this skin for future use [2,12]. The soft tissue overlying the base of the spine is at risk for developing pressure ulcerations, and removal of the spinous process of the most distal vertebrae can help to eliminate this problem [2].

Meningitis is another potential problem. When disarticulating the spine, the dura and cauda equina should be ligated and the spinal canal plugged with muscle. Failure to close the spinal canal has led to leakage of cerebrospinal fluid and recurrent meningitis. Short courses of antibiotics have been curative [12]. Postoperative intestinal obstruction has been reported, resulting in one patient death [2,9]. Two ileal conduit fistulae have been reported, one closed spontaneously after 3 months and one required surgical repair [9]. One cause for postop-

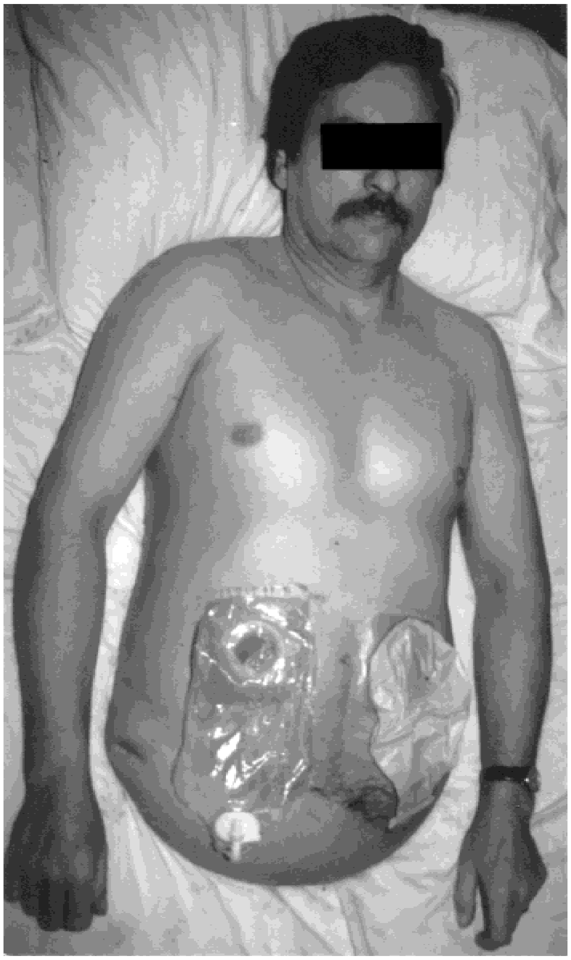

Fig. 1. Many months following surgery, demonstrating weight gain, ileostomy, and colostomy appliances.

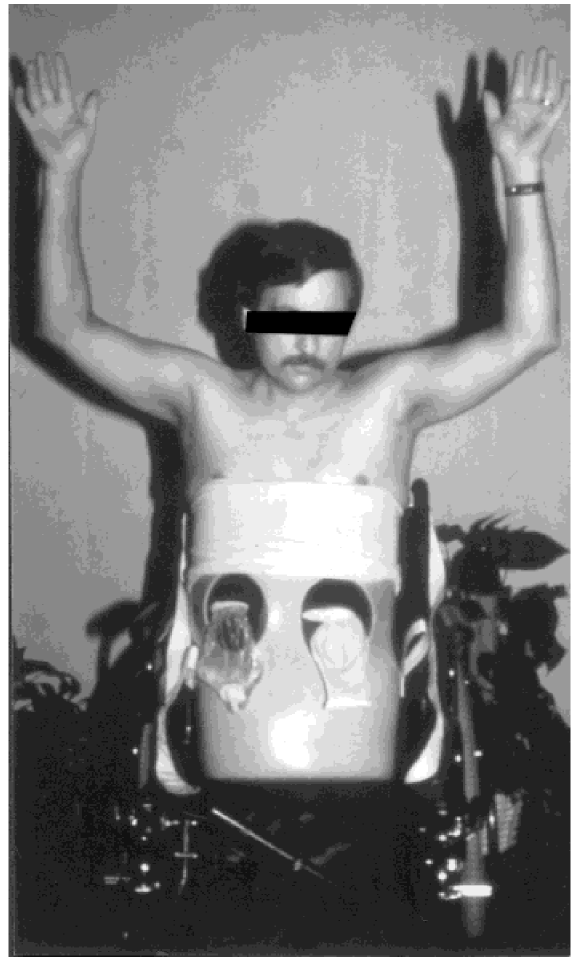

Fig. 2. Patient in the bucket appliance positioned on wheelchair. Careful preoperative site selection of ileostomy and colostomy stomas allows construction of a well-fitted bucket prosthesis.

erative anemia unexplained by blood loss was acute loss of bone marrow. Once other sites develop their marrow capacity, this ceases to be a problem [9]. Also described is heterotopic ossification at the distal end of the spine. This has been treated with resection and prophylactic radiation therapy [13]. Other complications include recurrent intraabdominal bleeding requiring reoperation, retroperitoneal abscess, renal failure, small bowel fistulae, and stress ulcers that were fatal on one occasion [2,9,13]. Pulmonary embolus was suspected in one patient [2].

OUTCOME

Long-term survival after hemicorporectomy is possible, but the statistics are not favorable. Perioperative mortality rates vary from approximately 25% for benign disease to 66% for malignant disease [2,20]. Death occurred frequently from distant metastases, with or without local recurrence [9]. Morbidity approaches 100% [20]. The best results have been obtained in patients who have undergone translumbar amputation for complications resulting from decubitus ulcers, be it benign or malignant disease [2]. In patients in whom paraplegia is congenital, emotional adjustments and rehabilitation are greatly facilitated. These individuals have never known normal sensory or motor function in the lower half of the body and are freed of useless extremities which hinder daily activities [15]. Results in patients with visceral malignancy are disappointing: 3 of 4 patients in the initial series of Miller et al. [7] died or were diagnosed with distant metastases within 1 year of operation. The patient surviving longest after hemicorporectomy lived over 28 years following surgery for advanced carcinoma of the bladder [8].

BUCKET

The design and construction of the bucket prosthesis demand planning and consideration. The patient must be fitted to avoid weight bearing on the lower spine (Figs. 1, 2). Weight gain after surgery results in bucket modifications or the necessity of constructing a larger prosthesis.

Rehabilitation is lengthy and difficult, but many patients have returned to the workplace. Some have returned to their preoperative occupations, including an architect, a musician, a computer worker, and a self-employed businessman in the insurance industry [2,9]. Others have achieved various forms of employment, including a nursing home attendant, a truck driver, and a checker in the garment industry [2,7]. Two patients have participated in the Handicapped Olympics, one in basketball and another earning a silver medal in weightlifting [2,5].

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COMMENTARY

This paper contains useful information on different aspects of this rare procedure. The undersigned had an unpublished case of hemicorporectomy in a paraplegic who developed, on the basis of decubitus ulcers, extensive squamous cell carcinoma of the lower back eroding into the distal sacrum. The procedure was carried out as a single-stage operation, but the bowel loops were fairly dilated at the end of this 10-hr procedure. It was not possible then to approximate the anterior and posterior flap because we had to resect a considerable amount of posterior skin and the loops of bowel were dilated. As a result, we placed a polypropylene (Marlex) mesh to hold the intestines in place. The immediate postoperative period was uneventful. However, in about a week or so, the patient presented with a fistula due to erosion of small bowel from the mesh. An attempt was made to resect the mesh at this point and the fistula was repaired, but the patient continued to present with new episodes of new fistula formation over the next few weeks. It was not possible to remove all of the mesh because it had been infiltrated by surrounding looops of bowel. After the patient was discharged, he presented again with episodes of fistulization over the next 6 months and finally died as the result of one of those episodes.

This experience suggests another reason for doing this operation n two stages, as the authors of the above paper suggest (i.e., the dilation of the loops of bowel that occurs due to the length of the procedure makes it more difficult or impossible to approximate the anterior and posterior flaps). Another point, of course, is to avoid using a mesh in direct contact with bowel loops [1]. If there is a gap between the anterior and posterior flap, some other type of reconstruction such as flap rotation should be carried out.

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REFERENCE

1. Karakousis CP, Volpe C, Tanski J, et al.: Use of a mesh for musculoaponeurotic defects of the abdominal wall in cancer surgery and the risk of bowel fistulas. J Am Coll Surg 1995;181:11–16.